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NATIONAL SECURITY RESEARCH DIVISION

An Excel Tool to Assess Acquisition Program Risk

Lauren A. Fleishman-Mayer, Mark V. Arena, Michael E. McMahon

Prepared for the Office of the Secretary of Defense

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Preface

The Department of Defense (DoD) relies on risk management analysis when acquiring large defense acquisition programs. Risk management helps decisionmakers ensure that objectives related to cost, schedule, and performance are met according to program goals. To that end, a team of RAND researchers created a Microsoft Excel–based tool (the Assessor Tool) to help DoD acquisition specialists identify system integration risk areas at any point in the acquisition process. This document offers a users' manual for the current integration risk application of the Assessor Tool (Version 1.0) and instructions for how to adapt the Assessor Tool for different applications. A complementary report describing the methodology behind the tool and its applications is available as RR-262-OSD, *A Risk Assessment Methodology and Excel Tool for Acquisition Programs* (Fleishman-Mayer, Arena, and McMahon, 2013).

This work should be of interest to those readers interested in risk assessment of major defense programs. The document does not assume an understanding of the DoD acquisition system. This research was conducted within the Acquisition and Technology Policy Center of the RAND National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the Unified Combatant Commands, the Navy, the Marine Corps, the defense agencies, and the defense Intelligence Community.

For more information on the Acquisition and Technology Policy Center, see http://www.rand.org/nsrd/ndri/centers/atp.html or contact the director (contact information is provided on the web page).

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Abbreviations[1]

ADM	Acquisition Decision Memorandum
AoA	analysis of alternatives
ASR	Alternative Systems Review
AT&L	Acquisition, Technology, and Logistics
BIT	Built In Test
CARD	Cost Analysis Requirements Description
CDD	Capability Development Document
CDR	Critical Design Review
CM	Configuration Management
CONOP	concept of operations
COTS	commercial off-the-shelf
CPD	Capability Production Document
CSCI	Computer Software Configuration Item
DAES	Defense Acquisition Executive Summary
DAMIR	Defense Acquisition Management Information Retrieval
DIACAP	DoD Information Assurance Certification and Accreditation Process
DMSMS	diminishing manufacturing sources and material shortages
DoD	U.S. Department of Defense
DOT&E	Director, Operational Test and Evaluation
DT	Developmental Test
ECP	Engineering Change Protocol
EMC	electromagnetic compatibility

[1] This list includes all of the abbreviations that appear in the Assessor Tool itself, not just those that are in this document.

EMI	electromagnetic interference
FoS	family of systems
FRP	Full-Rate Production
GFE	Government-Furnished Equipment
GOTS	government off-the-shelf
H, M, L	high, medium, low
HSI	human-system interface
ICD	interface control document
ICWG	Interface Control Working Group
IMS	Integrated Master Schedule
IPT	Integrated Product Team
IRL	Integration Readiness Level
IRR	Integration Readiness Review
IRS	Interface Requirement Specification
ITT	Integrated Test Team
JITC	Joint Interoperability Test Command
KPP	key performance parameter
MDD	Material Development Decision
MLDT	Mean Logistics Delay Time
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MS	milestone
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
NDI	Non-Developmental Item
NR-KPP	Net-ready Key Performance Parameter
N-M	Nunn-McCurdy
OIPT	Overarching Integrated Product Team
OSD	Office of the Secretary of Defense
OT	Operational Testing

OV	operational view
PCA	Physical Configuration Audit
PDR	Preliminary Design Review
PESHE	programmatic environment, safety, and occupational health evaluation
POPS	Probability of Program Success
PRR	Production Readiness Review
PSP	Product Support Plan
R&M	Reliability and Maintainability
RMA	Reliability, Maintainability, and Availability
SE	systems engineering
SEP	Systems Engineering Plan
SFR	System Functional Review
SI	system integration
SIDD	Software Interface Design Description
SoS	system of systems
SFR	System Functional Review
SRL	system readiness level
SRR	system requirements review
SSD	Spectrum Supportability Determination
SUBSAFE	Submarine Safety Program
SVR	system verification review
SWAP	size, weight, and power
T&E	test and evaluation
TDS	Technology Development Strategy
TEMP	test and evaluation master plan
TRL	Technology Readiness Level
TRR	Test Readiness Review
UUE	Unit Under Evaluation
WSARA	Weapon Systems Acquisition Reform Act

CHAPTER ONE

Introduction

On May 22, 2009, President Obama signed into law the Weapon Systems Acquisition Reform Act (WSARA) to improve program costs and schedules associated with the delivery of major weapon systems. Some of the oversight changes called for by WSARA depend on a program team's ability to measure and manage the various risks associated with system integration (SI). Because SI may be influenced by all elements of the acquisition process, there exists a wide range of sources for SI risk. At any point, problems with hardware or software, design maturity, timely funding, test plan execution and personnel, facilities, and supplier capabilities can negatively affect program cost, timelines, and performance goals. Historically, integration risks at various phases of the acquisition process have contributed in part to program delays and cost overruns. In response, the U.S. Department of Defense (DoD) has worked toward improving defense program management overall through program and contractor-level risk management practices (DoD, 2006).

Large defense programs can have many technical, legal, and political consequences. Thus, there are many stakeholders across DoD who need to identify the risks associated with DoD's overall weapons programs, as well as the individual technology projects within a program. To date, personnel from the Office of the Secretary of Defense (OSD) who have been more generally involved with weapon systems acquisition—but not necessarily involved with individual programs—have had no access to an OSD-level systematic method of determining a program's ability to meet its goals, or to monitor the success of the defense sector's compliance with WSARA over the acquisition lifecycle. The methods currently available to OSD personnel are too technically focused and are relevant only to personnel who have detailed knowledge at the individual program level.

The Excel information-based risk tool (referred to as the "Assessor Tool," or "tool" for short, for the remainder of the document) described herein (Version 1.0) is designed to assist the DoD acquisition community in assessing weapon SI risk in accordance with WSARA. A complementary report describing the methodology behind the tool and its applications is available as RR-262-OSD, *A Risk Assessment Methodology and Excel Tool for Acquisition Programs* (Fleishman-Mayer, Arena, and McMahon, 2013). The package offers an OSD-level approach to the evaluation and measurement of SI risk. That is, it is meant for assessors, such as OSD personnel, who may not be especially familiar with the specific program under evaluation but still may need to make judgments about the program's risk. The tool is a custom-designed software package in Excel that allows for easy accessibility of an OSD-level audience. Other systems engineering (SE) risk management software tools, such as a COTS (commercial off-the-shelf) SE tool (e.g., Lebron, Rossi, and Foor, 2000), may not be appropriate or easily avail-

able for this audience. While potentially not unique, the tool is tailored specifically to OSD personnel, allowing for its ease of use.

The Assessor Tool, developed by RAND researchers, is based on a tractable and comprehensive set of questions that can help evaluate integration risk at each point in the acquisition process. More specifically, the tool enables users to see how well integration risk is being managed by providing a standards-based valuation of integration issues that can lead to cost growth, schedule growth, and program performance shortfalls. These standards are based on the existence and completeness of DoD artifacts and checklists that would be readily available to an assessor at the OSD level. As requested by the OSD sponsor, we developed the tool and its methodology to help OSD-level acquisition professionals address these potential risks to major programs; early identification and reconciliation of SI issues as mandated by WSARA can reduce the likelihood and magnitude of the complications that frequently affect major weapons acquisition programs (Conrow, 1995). While we describe the Assessor Tool in terms of its appropriateness for major weapon systems acquisitions analysis, it should be noted that it is also generalizable to an entire set of OSD-level information-based risk assessment applications.

CHAPTER TWO

User Manual for Assessor Tool

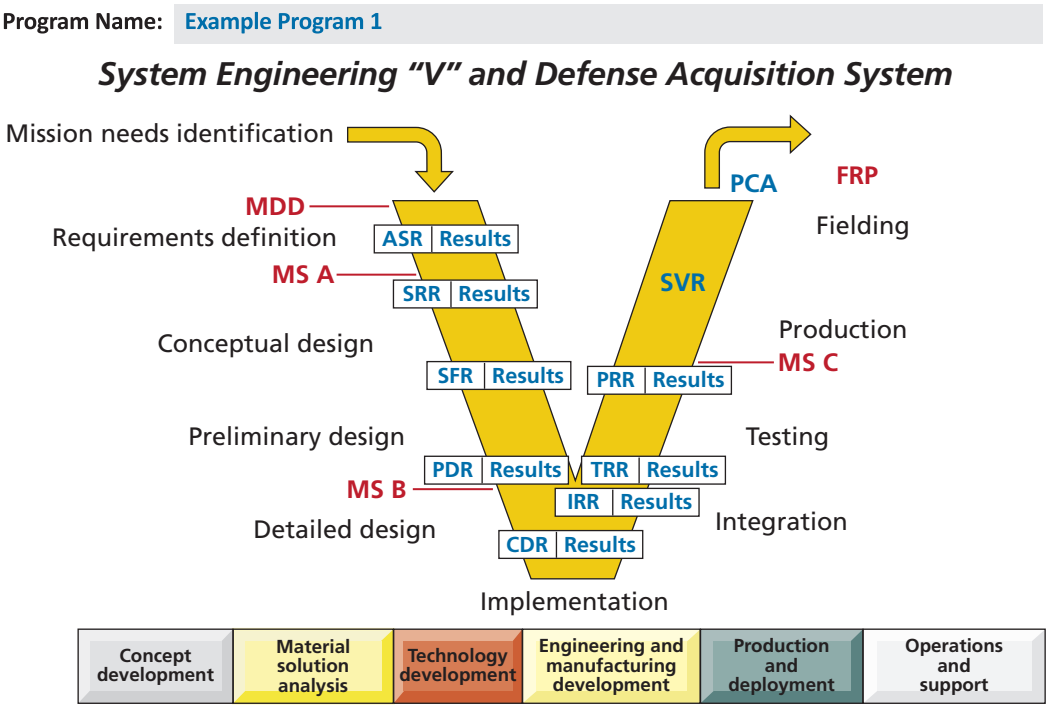
The Assessor Tool (Version 1.0) described in this document can be used in its existing application for assessing a weapon systems acquisition program's integration risk, as well as adapted for other programs and compliance risk assessments. This chapter provides step-by-step instructions to perform both of these functions. It assumes that users have read the main report (Fleishman-Mayer, Arena, and McMahon, 2013) and therefore does not provide detailed definitions of terms such as "secondary questions" or "relevant artifacts."

Instructions to Use the Existing Application of the Assessor Tool (Weapon Systems Acquisition Integration Risk)

This section contains step-by-step instructions for a user of the existing integration risk Assessor Tool. The instructions will lead the user through an exercise to assess a specific weapon systems acquisition program at a specific program phase (ASR, PDR, etc.). A user can use these instructions to answer the existing phase-specific and global questions as to their completeness and importance and can add questions tailored to the program under assessment.

1. Open the Excel file, enabling macros if possible.
2. The Excel file should open to the overview tab (see Figure 2.1). If not, find this tab at the bottom of the window and click on it.
3. At the top of the page, fill in the program name in the area highlighted in gray.
4. Click the button for the appropriate program phase (see Table 2.1) (ASR, PDR, etc.).
5. At the top of the page, fill in the assessor name and date.
6. For each program phase question (highlighted in blue), read the question. If it is a primary question, choose its level of importance on a scale from 1 (Little Importance) to 5 (Extremely Important). Next, for all primary and secondary questions, choose its appropriate "Assessment": Addressed, Partially Addressed, Not Addressed, or Not Applicable. If a primary question is Not Applicable, its corresponding secondary questions may be skipped.
7. The last five lines allow for the program phase questions to be tailored to a specific program. If there are applicable questions, type them into the blank spaces in the "Question" column. See Fleishman-Mayer, Arena, and McMahon, 2013, for a discussion of designing and properly framing questions for the tool.
    a. Organize questions such that secondary questions fall directly below the associated primary question.

Figure 2.1
Overview Tab of the Assessor Tool



NOTE: All abbreviations can be found in the Abbreviations list.
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b. In the column labeled ID, update the numbers to reflect the addition of secondary questions. That is, ID numbers for primary questions are given whole numbers, while secondary questions associated with the primary include the same whole number with an additional decimal, ascending in increments of 0.1 (e.g., a primary question with the ID 9 will have secondary questions with IDs 9.1, 9.2, etc.). *Note that skipping this step will cause there to be an error in the overall relative risk calculation.*
c. In the relevant artifacts and domain area columns, fill in as appropriate.
d. Next, choose the level of importance on a scale from 1 (Little Importance) to 5 (Extremely Important) for each of the custom primary questions. Note that the importance of custom secondary questions will be the same as their associated primary as long as all steps included in step 5 have been followed. Thus, there is no reason to assign an importance level to secondary questions.
e. For all custom primary and secondary questions, choose its appropriate "Assessment": Addressed, Partially Addressed, Not Addressed, or Not Applicable.

Table 2.1
Sample ASR Assessor Data Entry Phase

Program Name: Example Program 1 Assessor Name: Joe Smith Date: 6/13/2012

ID	Question	Technical Review	Relevant Artifacts	Domain Area	Importance	Assessment	Score	Weight	Relative Risk	Relative Risk (un-weighted)
1	Does the CONOPs identify the relationships, dependencies and desired interfaces envisioned between new or upgraded systems and other existing or planned systems?	ASR	CONOPs, OV-1, TDS	Design and Engineering	4 - Very Important	Partially Addressed	0.5	4	0.04	0.04
1.1	Does the operational views (OV-1) frame the operation concept (what happens, who does what, in what order, to accomplish what goal) and highlight interactions to the environment and other external systems?	ASR	OV-1	Design and Engineering		Not Addressed	1	4	0.08	0.07
2	Does the Initial Capabilities Document explain how the required capabilities are dependent upon interface with other systems? Does it also define interoperability requirements of the capabilities in terms of high-level Operational View (OV-1)?	ASR	Initial capabilities document, OV-1	Design and Engineering	2 - A little important	Not Applicable	0	0	0.00	0.00
3	Are the system and/or FoS/SoS reliability, maintainability, availability performance parameters identified?	ASR	SEP, initial capabilities document, CONOPs, OV-1	Logistics and Maintainability	3 - Somewhat important	Addressed	0	3	0.00	0.00
3.1	Has a formal DMSMS program been established?	ASR		Logistics and Maintainability		Partially Addressed	0.5	3	0.03	0.04
4	Has a draft Systems Engineering Plan been Developed?	ASR	SEP	Program Management	4 - Very Important	Partially Addressed	0.5	4	0.04	0.04
4.1	Has the Electromagnetic Spectrum supportability assessment factors been completed and submitted for spectrum supportably approval?	ASR	SSD, SEP	Design and Engineering		Not Addressed	1	4	0.08	0.07
4.2	Does the integrated architecture adhere to the DoD net-centric strategies?	ASR	Net Centric Data Strategy	Design and Engineering		Addressed	0	4	0.00	0.00
4.3	Is the system's architecture explicitly documented to the same level as the systems requirements? Does the architecture documentation describe the rationale for partitioning functionality and for placing key architectural attributes within or across a subset of architectural boundaries?	ASR	SEP	Design and Engineering		Addressed	0	4	0.00	0.00
4.4	Have HSI issues been integrated into the systems acquisition documentation?	ASR	SEP	Design and Engineering		Not Addressed	1	4	0.08	0.07
4.5	Does the program have a SoS engineering IPT?	ASR	SEP	Program Management		Addressed	0	4	0.00	0.00
5	Have software testing requirements been identified?	ASR	SEP, CARD	Test and Evaluation	5 - Extremely Important	Partially Addressed	0.5	5	0.05	0.04
6	Have the requirements for an integrated test facility been identified?	ASR	SEP, CARD	Test and Evaluation	4 - Very Important	Addressed	0	4	0.00	0.00
7	Did the AoA performance assessment adequately evaluate integration issues/FoS/SoS?	ASR	AoA	Design and Engineering	3 - Somewhat important	Partially Addressed	0.5	3	0.03	0.04
8	Have the requirements for integration test activites been identified and included in the cost estimate?	ASR	SEP, CARD	Test and Evaluation	3 - Somewhat important	Not Addressed	1	3	0.06	0.07
9		ASR			1 - Very Little Importance	Addressed	0	0	0.00	0.00
10		ASR			1 - Very Little Importance	Addressed	0	0	0.00	0.00
11		ASR			1 - Very Little Importance	Addressed	0	0	0.00	0.00
12		ASR			1 - Very Little Importance	Addressed	0	0	0.00	0.00
13		ASR			1 - Very Little Importance	Addressed	0	0	0.00	0.00
					Total ASR Relative Risk				0.46	0.46

NOTE: All abbreviations can be found in the Abbreviations list.

8. Scroll down on the page to find the global questions (highlighted in purple). See Table 2.2. For each global question, follow the same instructions in steps 6 and 7 above. Note that "Assessment" choices may be somewhat different than those for the program phase questions (e.g., Yes, Somewhat, No, Not Applicable; High, Medium, Low, Not Applicable).
9. Scroll to the very bottom of the program phase tab to reveal a button labeled "Results." Click the "Results" button or choose the results tab in Excel associated with the appropriate program phase.
10. Review the results report (e.g., Figure 2.2). See Fleishman-Mayer, Arena, and McMahon, 2013, for a further discussion of the results report. The buttons at the top of the page allow for the report to be printed and will direct the user back to the home page or back to the program phase questions.

Adapting the Assessor Tool for Other Programs or Information-Based Risk Assessments[1]

This section contains step-by-step instructions for a user of the Assessor Tool template. The instructions will lead the user through an exercise to create a tailored Assessor Tool, such as the example integration risk Assessor Tool described in Fleishman-Mayer, Arena, and McMahon, 2013. A user can use these instructions to create Excel tabs to hold questions about, and results for, multiple program phases. For instructions of how to assess the program associated with this adapted tool, a user may loosely follow the instructions presented previously for the integration risk application of the Assessor Tool.

1. Open the Assessor Tool template file (see Table 2.3).
2. If the program of interest has more than one program phase, make copies of the existing questions and results tab.
    a. Rename the tabs to reflect program phases. For example, for the ASR program phase, the questions tab could be named "ASR," and the results tab could be named "ASR Results."
    b. Go to each results tab and change all formula references to the corresponding questions sheet.
        - One way to do this:
            - Show all formulas in the tab using the "show formulas" option/command in Excel.[2]
            - Using "Find and Replace All," change the tab reference "Questions Template" to the name of the appropriate questions tab (e.g., ASR).
            - Hide all formulas.

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[1] Note that these instructions assume moderate-level Excel skills.

[2] To show formulas in Excel 2012, go to the File menu and select Options. It will bring up the Excel Options dialog. From the left sidebar, click Advanced, and from the right pane scroll down to find Display options for this worksheet group. Under this group, enable the "Show formulas in cells instead of their calculated result" option. Click OK to continue. To show formulas in Excel 2007 for the Mac, go to the Excel ribbon titled Formulas, and under the Function heading, select the Show label.

Table 2.2
Sample ASR Assessor Data Entry Phase, Global Questions

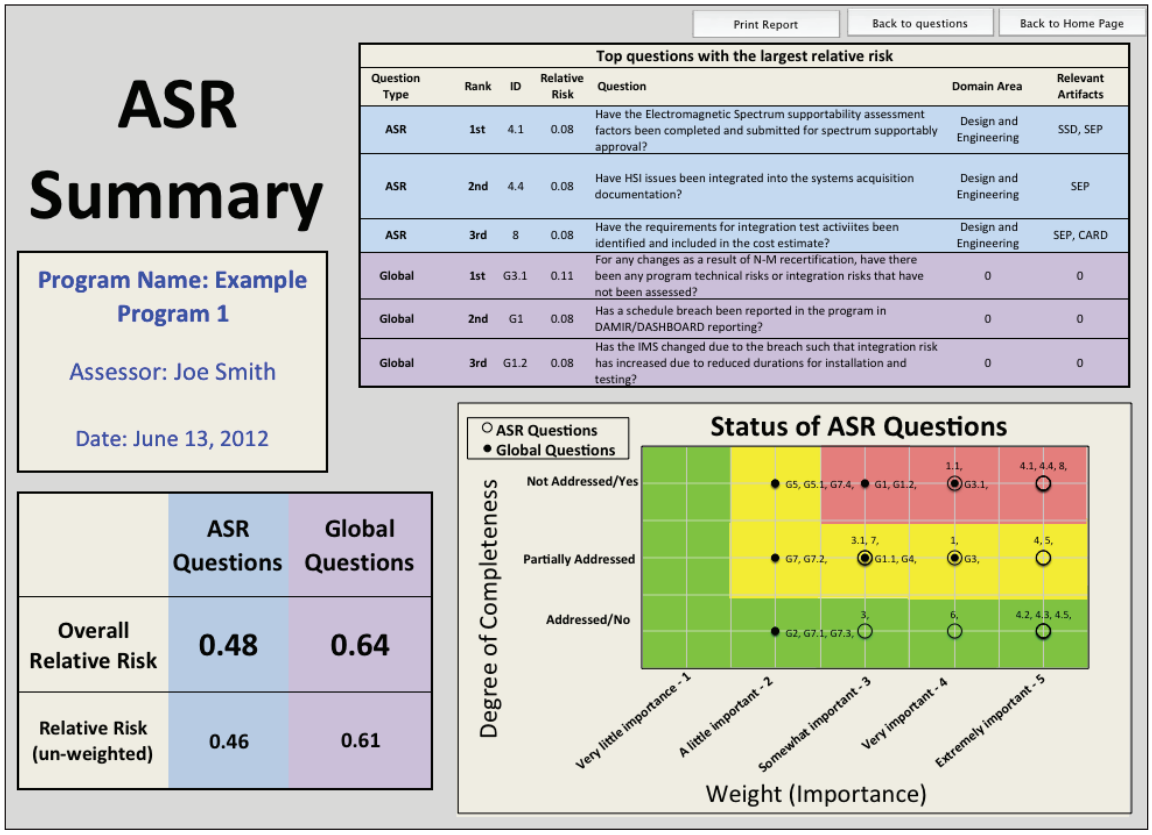
Program Name: Example Program 1 Assessor Name: Joe Smith Date: 6/13/2012

ID	Question	Technical Review	Relevant Artifacts	Domain Area	Importance	Assessment	Score	Weight	Relative Risk	Relative Risk (un-weighted)
G1	Has a schedule breach been reported in the program in DAMIR/DASHBOARD reporting?	ASR			3 - Somewhat important	Yes	1	3	0.08	0.07
G1.1	Was the schedule breach due to major system development, deliveries or production that increase integration risk?	ASR				Somewhat	0.5	3	0.04	0.04
G1.2	Has the IMS changed due to the breach such that integration risk has increased due to reduced durations for installation and testing?	ASR				Yes	1	3	0.08	0.07
G2	Have funding changes increased integration risk due to inadequate funds for testing or resulted in delays for technology insertion?	ASR			2 - A little important	No	0	2	0.00	0.00
G3	Has the program been identified for a Nunn-McCurdy breach?	ASR			4 - Very Important	No	0.5	4	0.06	0.04
G3.1	For any changes as a result of N-M recertification, have there been any program technical risks or integration risks that have not been assessed?	ASR				Yes	1	4	0.11	0.07
G4	Are there any technology risk issues identified in the most recent ADM that have not been addressed by the program?	ASR			3 - Somewhat important	Somewhat	0.5	3	0.04	0.04
G5	What is the DOT&E risk assessment for the program (H, M, L)?	ASR			2 - A little important	High	1	2	0.06	0.07
G5.1	Has any of the TEMP *not* been concurred and funded?	ASR				Yes	1	2	0.06	0.07
G6	Has a major sub-system or technology vendor failure occurred or vendor been disqualified or changed?	ASR			1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
G6.1	What is the associated integration risk effect on the program (H,M,L)?	ASR				Medium	0	0	0.00	0.00
G7	Have all required certifications or the planning to achieve required certifications at the appropriate time been addressed?	ASR			2 - A little important	Some	0.5	2	0.03	0.04
G7.1	Information Assurance (e.g. DIACAP and NSA Cryptographic Certification) ?	ASR				All	0	2	0.00	0.00
G7.2	Interoperability (e.g. Net Ready KPP, Joint Interoperability Test Certificate)?	ASR				Some	0.5	2	0.03	0.04
G7.3	Spectrum Management (e.g. EMI / EMC Cert., Spectrum Cert.)?	ASR				All	0	2	0.00	0.00
G7.4	Safety (e.g. Airworthiness, SUBSAFE, PESHE)?	ASR				None	1	2	0.06	0.07
G8		ASR			1 - Very Little Importance	Yes	1	0	0.00	0.00
G9		ASR			1 - Very Little Importance	Yes	1	0	0.00	0.00
G10		ASR			1 - Very Little Importance	Yes	1	0	0.00	0.00
G11		ASR			1 - Very Little Importance	Yes	1	0	0.00	0.00
					Total Global Relative Risk				0.64	0.61

Results Back to Home Page

NOTE: All abbreviations can be found in the Abbreviations list.

Figure 2.2
Results Page for Sample Run



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c. Change data references and labels in the graph.
   - To find data references: Right click with the pointer over the graph, choose "select data."
   - To change the labels, it may be necessary to download an Excel add-in.[3]

3. For each questions tab:
   a. After organizing questions such that secondary questions fall directly below the associated primary question, type phase-specific questions in the appropriate cells (into the blank spaces in the "Question" column). See Fleishman-Mayer, Arena, and McMahon, 2013, for a discussion of designing and properly framing questions for the tool.
   b. In the column labeled ID, update the numbers to reflect the addition of secondary questions. That is, ID numbers for primary questions are given whole numbers, while secondary questions associated with the primary include the same whole

[3] In Microsoft Excel, there is no built-in command that automatically attaches text labels to data points in an xy (scatter) chart. However, you can create a Microsoft Visual Basic for Applications macro that does this. There is an xy labeler add-in that does not require writing your own macro. See Application Professionals, not dated.

Table 2.3
Assessor Tool Template File

Program Name:	Example Program	Program Stage:	Stage 1	Assessor Name:	Joe Smith	Date:	6/13/12

ID	Question	Relevant Artifacts	Domain Area	Importance	Assessment	Score	Weight	Relative Risk	Relative Risk (un-weighted)
	STAGE-SPECIFIC QUESTIONS								
1	Replace with question 1			1 - Very Little Importance	Partially Addressed	0.5	1	0.08	0.13
1.1	Replace with question 1.1			2 - A little important	Partially Addressed	0.5	1	0.08	0.13
2	Replace with question 2			3 - Somewhat important	Not Addressed	1	3	0.50	0.25
3	Replace with question 3			1 - Very Little Importance	Addressed	0	1	0.00	0.00
5				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
6				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
7				3 - Somewhat important	Not Applicable	0	0	0.00	0.00
8				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
9				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
10				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
11				2 - A little important	Not Applicable	0	0	0.00	0.00
12				2 - A little important	Not Applicable	0	0	0.00	0.00
13				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00
14				1 - Very Little Importance	Not Applicable	0	0	0.00	0.00

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number with an additional decimal, ascending in increments of 0.1 (e.g., a primary question with the ID 9 will have secondary questions with IDs 9.1, 9.2, etc.). *Note that skipping this step will cause there to be an error in the overall relative risk calculation.*

c. In the relevant artifacts and domain area columns, fill in as appropriate.
d. Note that the template allows for the inclusion of 50 phase-specific questions and 30 global questions per program phase.

CHAPTER THREE

Conclusion

This document presented the User Manual for the Assessor Tool, which can be used to facilitate an OSD-level information-based risk assessment for acquisition or other major programs. A complementary report describing the methodology behind the tool and its applications is available as RR-262-OSD, *A Risk Assessment Methodology and Excel Tool for Acquisition Programs* (Fleishman-Mayer, Arena, and McMahon, 2013). The tool includes a generalizable form of the Assessor Tool as well as the integration risk Assessor Tool provided as an example application. The reproducible and documented tool for integration risk assessment may be considered for program office reporting to meet WSARA compliance as well as for other acquisition reviews, such as the OSD Defense Acquisition Executive Summary and Overarching Integrated Product Team reviews, and for adaptation into other program assessment tools, such as the Probability of Program Success tool. As of this writing, the Assessor Tool has not yet been validated in a real-world setting. Potential future work could include its validation.

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